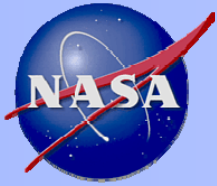


# **Joint Cost and Schedule Confidence Level (JCL)**

**A Status Report**

February 2010



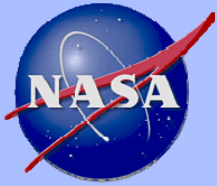
# Topics

- JCL policy review
- Why new confidence policy
- Implementation details and SMC and PMC decisions
- Status of program and project JCLs
- Quality standards
- Project feedback to date
- Observations and lessons learned
- Next steps



## Recap of NPD 1000.5

- Programs to be baselined at a 70% joint confidence level (a 70 percent probability the program's projects will be completed at or below the estimated cost & at or before the projected schedule).
- Projects to be baselined/budgeted at JCL that supports the program approved JCL
- Projects to be funded at no less than a 50% JCL or as approved by the decision authority
- JCLs to be developed and maintained through lifecycle beginning at KDP-I or KDP-C
- Programs in extended operations generally not required to develop JCL, but new or upgraded capabilities within ops will develop JCL
- Program and project proposed cost and schedule baselines will be assessed by an independent review team
- External commitments will be based on JCL approved by the responsible Agency management council
- Programs and projects are annually reviewed by MD or MSO to confirm that current baselines and JCL are consistent with their annual budget submit. Significant changes to funding are to be reviewed and approved by the responsible Agency management council



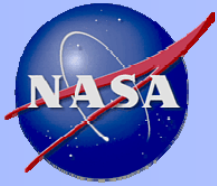
# Review of Policy Purpose

- Provide stronger assurance to stakeholders that NASA could meet cost and schedule targets
  - Original confidence policy stated that agency would budget projects at the 70% confidence level of an independent estimate
  - Original policy was silent about meeting schedule targets; only cost
- Provide an more transparent mechanism to communicate the consequences of Congressional or OMB funding changes, i.e., reductions to funding change the probability of meeting cost and schedule commitments



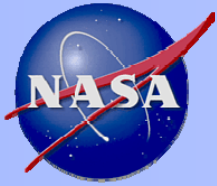
# Implementation Details and SMC and PMC Decisions

- Implementation plan was to “just do it” now and to continuously evolve the process and products.
- Office of Chief Engineer chartered a JCL Working Group to recommend derived requirements, flow down, and communication strategy
  - Included representatives from SMD, ESMD, SOMD, MSFC, GSFC, JPL, OCFO, OSMA and PA&E
- The 18 May 2009 SMC accepted the Working Group’s recommendations, but the 17 December PMC provided more specific direction:
  - The Program Manager is responsible for the Program JCL
  - JCLs must be computed for KDP-C based on probabilistic resource loaded schedules
  - Exceptions must be granted a formal waiver by OCE
  - A JCL re-calculation may be required by BPR leadership based on project performance. PA&E and OCE are to use existing metrics or new factors for purpose of tracking performance
  - Projects that are very late in the development cycle, need not develop a JCL and PA&E is to develop an alternative method of calculating the Program JCL



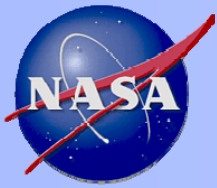
# Implementation Details (Concluded)

- SMC and PMC direction (concluded)
  - PA&E to develop guidance on uncertainty factors used in the JCL computation
  - Develop a pilot program to examine the benefits of performing parametrically-based JCLs at KDP B
    - SMAP, MAVEN, and LADEE identified.
    - LADEE subsequently re-directed based on imminent KDP C



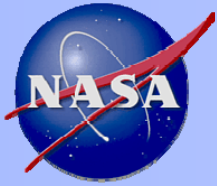
# Status of Program and Project JCLs

- PA&E providing consulting support to help programs and projects develop JCLs
  - Completed: MMS, LDCM, and SOFIA
  - Pilot project: MAVEN
  - In-process: JWST, LADEE and MAVEN
- CxP developing own JCL
- JPL developing JCL for its projects
  - Completed: MSL and NuStar
  - Pilot project: SMAP
- IT Program and projects
  - Planned to start in February 2010



# Status of Program and Project JCLs

Theme	Program	Project	Milestone	Milestone Date	JCL Status	Rationale
Astro	Explorer	WISE	LRD	12/2009	Launched. N/A	
Astro	Explorer	NuStar	KDP-C	6/2009	Complete	
Astro	Explorer	GEMS	KDP-B	6/2009	Not Required until KDP-C	
Astro	Cosmic Origins	JWST	Rebaseline	2/2010	In Process	
Astro	Cosmic Origins	SOFIA	Rebaseline	2/2010	Completed but being updated	
Earth	ESM	GLORY	KDP-D	1/2008	Not required per APMC	Project near launch. Low return of effort. Use alternative approach
Earth	ESSP	Aquarius	KDP-D	6/2009	Not required per APMC	Per implementation decision at SMC and PMC
Earth	ESM	NPP	KDP-D	11/2008	Not required per APMC	Project near launch. Low return of effort. Use alternative approach
Earth	ESM	LDCM	KDP-C	12/2009	Completed	
Earth	ESM	SMAP	KDP-B	11/2009	Pilot KDP-B JCL Completed	
Earth	ESM	GPM	KDP-C & CDR	12/2009	Deferred and in-process	
Earth	ESM	ICESAT II	KDP-B	5/2010	Not Required until KDP-C	



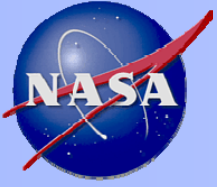
# Status of Program and Project JCLs (Concluded)

Theme	Program	Project	Milestone	Milestone Date	JCL Status	Rationale
Helio	LWS	SDO	LRD	1/2010	Not required per APMC	Project near launch. Low return of effort. Use alternative approach
Helio	LWS	RBSP	KDP-C	10/2008	Prior to NPD 1000.5. Performance being monitored	Per implementation decision at SMC and PMC
Helio	Explorer	IRIS	KDP-B	6/2009	Not Required until KDP-C	
Helio	LWS	Solar Probe Plus	KDP-B	6/2010	Not Required until KDP-C	
Helio	STP	MMS	KDP-C	7/2009	Completed	
Planetary	NF	JUNO	KDP-D	4/2010	Performance being monitored	Per implementation decision at SMC and PMC
Planetary	Discovery	GRAIL	KDP-D	7/2010	Performance being monitored	Per implementation decision at SMC and PMC
Planetary	MEP	MSL	Rebaseline	Ongoing	Completed but being updated	
Planetary	Lunar Quest	LADEE	KDP-C	2/2010	In Process	
Planetary	MEP	MAVEN	KDP-C	7/2010	In Process	
SOMD	SCaN	TDRS-K	KDP-C	6/2009	Deferral letter in process	
Exploration	CxP	ORION	KDP-C	5/2010	In Process	
Exploration	CxP	ARES	KDP-C	5/2011	In Process	
Exploration	CxP	Ground Ops	KDP-C	5/2012	In Process	
Exploration	CxP	Mission Ops	KDP-C	5/2013	In Process	
Exploration	CxP	EVA	KDP-C	5/2014	In Process	



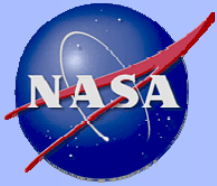
# General JCL Quality Standards

- Overarching principles: Transparent, traceable, defensible and timely (T, T, D & T)
- Cost and schedule base-estimates must
  - Have a clear basis for the estimates
  - Include all the cost elements and schedule activities
  - Be supported by relevant data
- All possible risks, threats, liens, uncertainties, mitigation strategies and opportunities must be explicitly quantified
  - Probability of occurring
  - Estimated cost, schedule (or both) consequences
- Address available annual resources
- Incorporate impacts of cost and schedule performance to date
- Risks must be transparently incorporated into cost, schedule and/or both
- JCL product documentation/model must describe
  - Basis for base schedule duration and logic
  - Basis for base cost estimates
  - Risks included and basis for probability and consequences
  - Risks excluded and why
  - Description of JCL method used



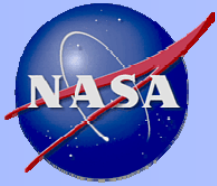
# Project Feedback to Date

- Adds a new requirement without dropping any of other requirements
  - Still had to reconcile with other estimates
  - Not staffed to do
  - Not equipped or trained to do
- Process of creating integrated master schedule, resource loading the schedule, and assigning probabilities was onerous
- Impact of discrete risks to project cost or schedule was overshadowed by uncertainty assignments (perceived as arbitrary)
- Assignment of uncertainty and correlation was not well understood or readily transparent to all
- Models took too long to perform “what-if” analyses because the model was at too low a level of detail and because of model inefficiencies
- Took 7-12 staff months to develop
- JCL models will be cumbersome to maintain



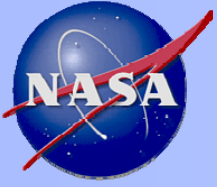
# Observations and Lessons Learned

- Observations:
  - JCL process requires integrated master schedule that is linked with cost and risk and much time and effort was spent developing an integrated resource loaded schedule
  - Project personnel are unfamiliar with developing resource-loaded schedules and associated tools
  - Projects need more experienced personnel to meet this requirement
- Lessons learned:
  - Develop models at an appropriate level of detail that is useful to management and at the same time is maintainable
  - Explain techniques to reduce Monte Carlo simulation times
  - Ensure all risks are quantified and understood by all
    - Discrete risks
    - Uncertainty from history
  - Provide guidance on uncertainty factors



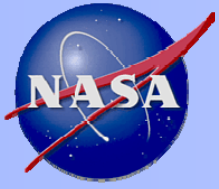
## Next Steps

- Explore the potential for an alternate method to calculate program JCLs when member projects are not available
- Provide status report on the value of the parametric-based JCL pilot projects (MAVEN and LADEE)
- Publish and distribute guidelines on uncertainties and educate project staffs on their use
- Complete JCL handbook informed by JCL experience
- Periodically update the SMC and PMC on JCL development progress

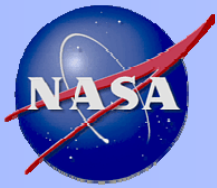


## Next Steps (Concluded)

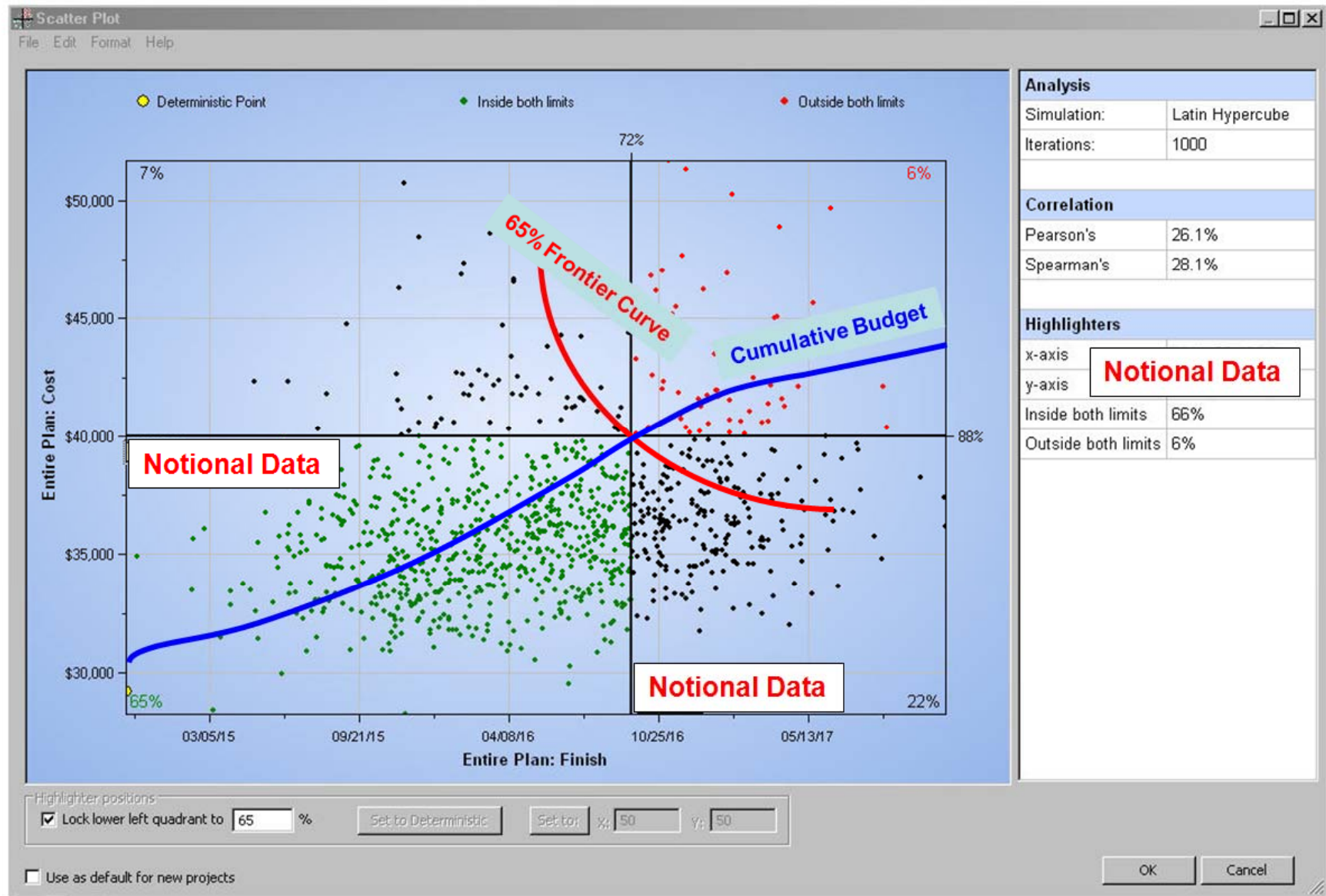
- Assist OCE-led working group to develop alternate methods of assuring that projects establish credible technical, cost and schedule estimates at KDP-B, i.e., better basis of estimates/evidence of realistic plans
  - Analogous project experiences
  - Realism about mass and other technical data growth rates
  - Realism concerning complexity, heritage, and technology readiness levels
  - More comprehensive discussion of risks and the possible impact to plans and corresponding reserves



# Backup



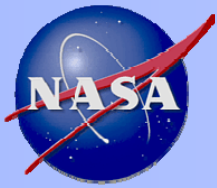
# Two Dimensional View of a JCL





# JCL is a Paradigm Shift

- JCL integrates cost, schedule and risks
- “Reserves” are driven by the quantification of the risk vice a set “design standards”
- If we want projects to meet cost and schedule commitments, we must budget and fund them with a higher probability of success
- Difference between agreed to JCL for budgeting and amount allocated to projects determine the Unallocated Future Expenses (UFE), previously referred to as Management Reserves. UFE is necessary for a project’s success



# Unallocated Future Expenses (UFE)

**X = Project most likely point estimate**

**Y = Cost estimate where there is a 65% chance that final actual cost will be less than cost estimate**

**Y-X = Total Unallocated Future Expenses (UFE) REQUIRED to meet 65 % CL**

**Z = Project requirement with project-assigned UFE (Z-X)**

